be manufactured in a simple manner. For example, the first SRR **1001** and the second SRR **1002** may be formed by etching the front surface and the rear surface of the dielectric **1003**, or the first SRR **1001** and the second SRR **1002** may be simply bonded to the front surface and the rear surface of the dielectric **1003**. In addition, because the antenna device **1500** in accordance with the embodiment of the present invention can be realized by forming the first SRR **1501** and the second SRR **1502** on the front surface and the rear surface of the dielectric **1503** located between the inverted-L element conductor **1504** and the ground conductor **1506**, the antenna device **1500** can be manufactured in a simple manner. For example, the first SRR **1501** and the second SRR **1502** may be formed by etching the front surface and the rear surface of the dielectric **1503**, or the first SRR **1501** and the second SRR **1502** may be simply bonded to the front surface and the rear surface of the dielectric **1503**. Because it is possible to easily adapt with the situation in which a design is changed to allow the antenna devices **1000** and **1500** to operate in a desired frequency band, the manufacturing cost can be reduced.

[0102] Moreover, the dielectrics **1003** and **1503** in accordance with an embodiment of the present invention may be formed of a flexible dielectric film and such. When the dielectrics **1003** and **1503** are manufactured using a flexible dielectric film substrate, because the dielectrics **1003** and **1503** can be bent, the dielectrics **1003** and **1503** can be easily mounted in a wireless communication apparatus. Furthermore, in addition to the dielectrics **1003** and **1503**, the element conductors **1004** and **1504** or the ground conductors **1006** and **1506** may be formed using a flexible material.

[0103] FIGS. **16**A to **16**C illustrate plan views of other shapes of a SRR of the antenna device in accordance with an embodiment of the present invention. FIG. **16**A illustrates the shape of a SRR **1601** that includes an opening **1601***a* formed by removing a part of a polygonal shape, FIG. **16**B is a diagram illustrating the shape of a SRR **1602** that includes an opening **1602***a* formed by removing a part of a rectangular shape, and FIG. **16**C is a diagram illustrating the shape of a SRR **1603** that includes an opening **1603***a* formed by removing a part of a ring shape. The present invention is not limited to the above shapes and includes any shape that can realize the characteristics of the SRR as described above.

[0104] FIG. **17** illustrates a block diagram of the configuration of a wireless communication apparatus provided with an antenna device in accordance with an embodiment of the present invention. The wireless communication apparatus **1700** in accordance with an embodiment of the present invention includes the antenna device **1701** that includes a SRR, a communication unit **1702**, an operation unit **1703**, a display unit **1704**, and a control unit **1705**.

[0105] The communication unit **1702** transmits/receives various control signals and data signals to/from an external communication system or a base station (not shown) through the antenna device **1701** under the control of the control unit **1705**, and simultaneously outputs received information to the control unit **1705**. The control unit **1705** includes a CPU, a ROM, a RAM, an interface, through which signals are input/output to/from the communication unit **1702**, the operation unit **1703** and the display unit **1704**, and such, and controls the entire operation of the wireless communication apparatus **1700** based on control programs stored in the ROM. For example, the control unit **1705** receives signals from the operation unit **1703**, displays a predetermined image on the display unit **1704**, and transmits/received data to/from the communication unit **1702**. Because the wireless communication apparatus **1700** uses the antenna device **1701** that includes the SRR, the wireless communication apparatus **1700** can be easily applied to a next generation communication system, such as LTE **700**, through a design modification thereof, and can be fabricated in a small size.

[0106] In accordance with the embodiments of the present invention as described above, the SRRs are disposed on the front surface and the rear surface of the dielectric located between the inverted-L conductor and the ground conductor, resulting in the achievement of a wavelength shortening effect which is larger than a wavelength shortening effect due to the material constant. Furthermore, because the resonant frequency of the inverted-L antenna can be shifted to a low frequency side, the antenna can be fabricated in a small size.

[0107] In addition, both the lengths of the inverted-L shaped element conductor and the conductor of the SRR are modified, resulting in the achievement of wide band characteristics by which an operation in a desired frequency band is possible.

[0108] The antenna device in accordance with the embodiments of the present invention may be applied to antenna devices used for various mobile information terminals including cell phones, personal computers, and any electronic device capable of wireless communication.

[0109] According to an antenna device and a wireless communication apparatus that includes an antenna device in accordance with an embodiment of the present invention, even if the number of frequency bands used increases, the antenna device can be fabricated in a small size without the increase in the structure thereof and a resonant frequency can be easily changed in a desired frequency band.

[0110] Furthermore, according to an antenna device and a wireless communication apparatus that includes an antenna device in accordance with an embodiment of the present invention, a wavelength shortening effect, which is larger than a wavelength shortening effect due to the material constant, can be achieved and a resonant frequency can be shifted to a low frequency side, such that the antenna device and the wireless communication apparatus that includes an antenna device can be fabricated in a small size. In addition, parameters (the length of a conductive member, the size of an opening, a relative position and the like) regarding the conductive member constituting the antenna device may be adjusted, such that an operation in a desired frequency band is possible. Consequently, it is possible to provide the antenna device and the wireless communication apparatus that includes an antenna device, which can easily achieve wide band characteristics.

[0111] Although the present disclosure has been described with an exemplary embodiment, various changes and modifications may be suggested to one skilled in the art. It is intended that the present disclosure encompass such changes and modifications as fall within the scope of the appended claims.

What is claimed is:

1. An antenna device comprising:

a dielectric comprising a first and a second substantially planar surfaces facing in substantially opposite directions;

an inverted-L antenna disposed at a side of the dielectric;

a first conductive member forming a first loop comprising a first gap, a planar side of the first loop disposed facing the first substantially planar surface of the dielectric; and